

Teamwork and Communication

Does Teamwork Improve Performance in the Operating Room? A Multilevel Evaluation

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Medical care today is undeniably a team effort. No provider can complete the continuum of care alone; communication, cooperation, and coordination are vital to effective care.¹ Although it has been a decade since the Institute of Medicine (IOM) report *To Err Is Human*² highlighted teamwork as one mechanism for enhancing care quality and safety, recent statistics indicate that a focus on the impact of teamwork remains imperative.³ For example, communication, a core component of teamwork, was cited by The Joint Commission as root cause in many (nearly 70%) sentinel events.⁴ Although the 2009 benchmarking database for the Agency for Healthcare Quality and Research's (AHRQ) Hospital Survey on Patient Safety Culture (HSOPS) indicates that 79% of 196,462 providers felt positively about the teamwork within their units, only 62% felt positively about the communication openness, and only 44% felt positively about handoffs and transitions.⁵

This article describes the results of an evaluation study conducted as part of a quality improvement project aimed at optimizing teamwork behavior among operating room (OR) teams within a large community hospital system. The project involved a multilevel, scientifically based evaluation of the TeamSTEPPS™ training program, including a nontrained comparison group. We begin by defining key terminology, the impetus behind this project, and key research questions.

Teams and Teamwork

A *team* is an identifiable set of two or more individuals interacting within a larger organizational context to reach a common goal through specific interdependent roles and task boundaries.^{6,7} The interdependent nature of the tasks in which teams engage requires individual members to adapt their own inputs and efforts to those of their teammates to accomplish shared goals.^{8,9} *Teamwork* is defined in terms of the behaviors (for example, backup behavior, closed-loop communication), cognitions (shared mental models), and attitudes (cohesion, collective efficacy) that make interdependent performance pos-

Article-at-a-Glance

Background: Medical care is a team effort, especially as patient cases are more complex. Communication, cooperation, and coordination are vital to effective care, especially in complex service lines such as the operating room (OR). Team training, specifically the TeamSTEPPS™ training program, has been touted as one methodology for optimizing teamwork among providers and increasing patient safety. Although such team-training programs have transformed the culture and outcomes of other dynamic, high-risk industries such as aviation and nuclear power, evidence of team training effectiveness in health care is still evolving. Although providers tend to react positively to many training programs, evidence that training contributes to important behavioral and patient safety outcomes is lacking.

Method: A multilevel evaluation of the TeamSTEPPS training program was conducted within the OR service line with a control location. The evaluation was a mixed-model design with one between-groups factor (TeamSTEPPS training versus no training) and two within-groups factors (time period, team). The groups were located at separate campuses to minimize treatment diffusion. Trainee reactions, learning, behaviors in the OR, and proxy outcome measures such as the Hospital Survey on Patient Safety Culture (HSOPS) and Operating Room Management Attitudes Questionnaire (ORMAQ) were collected.

Results: All levels of evaluation demonstrated positive results. The trained group demonstrated significant increases in the quantity and quality of presurgical procedure briefings and the use of quality teamwork behaviors during cases. Increases were also found in perceptions of patient safety culture and teamwork attitudes.

Discussion: The hospital system has integrated elements of TeamSTEPPS into orientation training provided to all incoming hospital employees, including nonclinical staff.

sible.^{10,11} Teamwork has been linked to important patient outcomes such as reduced risk-adjusted ICU mortality, reduced nursing turnover, and increased patient satisfaction.¹² In addition, provider communication has been linked to important outcomes such as job satisfaction, job stress, and turnover.¹³

OPTIMIZING TEAMWORK IN HEALTH CARE

The focal question for providers, administrators, and patients is how to turn groups of clinical experts into expert teams. Team training is one mechanism for equipping frontline providers and administrators with the knowledge, skills, and attitudes to work as expert team members. Other high-risk communities (for example, aviation, nuclear power) have adopted team training industrywide, achieving significant improvements in safety and working environments.^{14–17}

In health care, the U.S. Department of Defense (DoD), AHRQ, and leading members of the scientific community have drawn on the science of team training through an iterative process to develop and publicly release an evidence-based, practical team-training strategy toolkit named Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program.¹⁸ TeamSTEPPS (1) aims to facilitate provider communication and teamwork by optimizing information exchange, situational monitoring, leadership, team structure, and mutual support;^{19,20} (2) integrates didactic lecture with practice scenarios and tools (for example, pocket guides) designed to support effective teamwork in daily care; and (3) provides a comprehensive strategy for organizational change management, including project planning and organizational assessment tools, methods to enhance executive engagement, and evaluation tools.

Following the 2006 public release of the TeamSTEPPS program, the DoD and AHRQ joined with the American Institute for Research (AIR) to form the National Implementation of TeamSTEPPS Project,²¹ a national network providing support and training to health care facilities seeking to use TeamSTEPPS. Five team resource centers (TRCs)* were established to conduct three-day Master Trainer training courses. In turn, Master Trainers provide TeamSTEPPS training to administrators and frontline providers in their organization or other facilities. More than 1,000 individuals, representing a broad range of disciplines and more than 200 organizations, have been trained through the National Implementation.^{21,22}

* Duke University Medical Center (Durham, NC), Carilion Clinic (Roanoke, VA), University of Minnesota Fairview Medical Center (Fairview, MN), Creighton University Medical Center (Omaha), and University of Washington Medical Center (Seattle).

Through this network of Master Trainers, over 5,000 individuals have participated in TeamSTEPPS training. Trainers in the current project participated in the TeamSTEPPS Master Trainer program conducted at Carilion Clinic and the University of Minnesota, Fairview, in March–April 2008.

IMPETUS FOR CURRENT QUALITY IMPROVEMENT PROJECT (QIP)

The current QIP focused specifically on optimizing OR teamwork and was conducted at two campuses of a large southeastern community hospital system. The project's impetus stemmed from analyses of annual patient safety culture survey results (HSOPS) and root cause analyses of past events and near misses. Results mirrored nationally collected statistics suggesting communication and teamwork as opportunities for improvement.

The intervention-planning team, which was created in January 2008, was composed of a broad range of members at both the system and campus levels, including members of the system office of quality and safety innovation and research [L.A., M.M.], system surgical services director [M.B.], clinical educator manager of system surgical services, system director of anesthesiology, campus patient safety and quality officers [S.A.K.], campus surgical services administrators, and campus clinical educator for surgical services. Frontline providers, including surgeons, circulators, technicians, and anesthesiologists, also provided input into initial planning, as well as the design of briefing/debriefing checklists included in training.

The planning team selected TeamSTEPPS because of its grounding in the existing evidence base suggesting that teamwork and team training are meaningfully related to patient safety^{23–27} and cost-effectiveness of care.²³ The following two central research questions provided the foundation for evaluation efforts:

1. Does TeamSTEPPS training meaningfully affect teamwork behavior among OR teams?
2. Does this teamwork positively impact important outcomes such as patient safety culture?

These questions grounded evaluation efforts in a multilevel perspective. As pinpointed in the 2008 RAND report,¹² the majority of team-training evaluations in health care focus on trainee reactions. Thus, evidence regarding the impact of such team training programs on actual team behavior, team member perceptions of teamwork, and important patient and organizational outcomes remains unclear. The purpose of the current QIP was to simultaneously improve teamwork among OR team members and shed light on the impact of the TeamSTEPPS program using a quasi-experimental research design.

Table 1. Experimental Design Used for Evaluation*

		Observation & Surveys I (–1 month)	TS Training	Observation & Surveys II (+1 month)
Treatment (Trained)	Surgeon 1	10 surgeries	X	10 surgeries
	Surgeon 2	10 surgeries	X	10 surgeries
	Surgeon 3	10 surgeries	X	10 surgeries
Control (Nontrained)	Surgeon 4	10 surgeries	—	10 surgeries
	Surgeon 5	10 surgeries	—	10 surgeries
	Surgeon 6	10 surgeries	—	10 surgeries

* TS, TeamSTEPPS; –1 month, one month before training; +1 month, one month after training.

Table 2. Participant Demographics*

		Number of Participants	Average Age	Average Number of Years in Current Position	% Working over 40 Hours per Week	% Previous Team Training Experience
Treatment (Trained)	Surgeon	3	41	3.5	66%	33%
	CRNA	6	42	6.3	66%	0%
	Nurse	3	45.3	5.3	33%	0%
	Surgical Tech	3	50	7.5	33%	0%
	Anesthesiologist	12	42.1	7.1	33%	0%
	Physician Assistant	2	36	4	83%	0%
Control (Nontrained)	Surgeon	2	53.3	12	100%	0%
	CRNA	5	40.7	6.2	60%	0%
	Nurse	13	48	16.5	23%	0%
	Surgical Tech	3	55.5	11	0%	0%
	Anesthesiologist	3	48	17	66%	0%
	Physician Assistant	NA	NA	NA	NA	NA

*CRNA, certified registered nurse anesthetist; Tech, technician; NA, not applicable.

Methods

DESIGN

As depicted in Table 1 (above), this evaluation was a mixed-model design with one between-groups factor (TeamSTEPPS training versus no training) and two within-groups factors (time period, team). The groups were located at separate campuses to minimize treatment diffusion.

PARTICIPANTS AND SETTING

Participants were recruited by hospital and OR administrators in February–March 2008. Three surgeons and their teams, as well as the contracted anesthesiology providers, volunteered to participate in the training and evaluation efforts at each campus. Evaluation efforts were conducted under Institutional Review Board approval with informed consent.

Both campuses were community-based hospitals centrally located in metropolitan areas.

Trained Campus. The trained campus, which included 112 beds and 11 surgical suites, averaged on an annual basis more

than 10,200 admissions (including more than 3,100 inpatient surgical procedures and more than 2,900 outpatient surgical procedures) and more than 52,400 emergency department (ED) visits.

Nontrained Control Campus. The nontrained control campus included 297 beds, and on an annual basis averaged more than 15,000 patient admissions (including more than 8,700 surgical procedures) and more than 39,000 ED visits.

Table 2 (above) presents demographics relevant for participants at each campus. The case mix for the trained teams included orthopedic, general surgery, and bariatric cases. The case mix for the nontrained comparison group included orthopedic, general surgery, and gynecological cases. There was no clinical cross-coverage between campuses.

TRAINING INTERVENTION

The training curriculum was based on the TeamSTEPPS program²⁸ as described previously. Specific targeted competencies are shown in Table 3 (page 136). Training, conducted in

Table 3. Core TeamSTEPPS Competencies and Tools Targeted During Training

Teamwork Competency: Communication

■ Trained Behaviors and Tools

- Precase briefing
- All team members present
- Initiated by surgeon
- New team member introduced
- Critical case information shared by all team members
- Contingency plan
- Opportunity for questions
- Red flag statement by surgeon: “If anyone sees anything unsafe or not in the best interest of the patient, I expect you to speak up and bring it to our attention.”

■ Time-Out/Pause for the Cause

- Confirmation of the patient’s identity
- Correct side and site
- Agreement on the procedure to be performed

■ SBAR

- Situation, Background, Assessment, Recommendations

■ Handoffs

- Structured (SBAR used)
- Responsibility is established
- Responsibility is acknowledged
- Opportunity to ask questions, clarify, & confirm

■ Call-Out

- Critical information is literally “called out” verbally so all team members can hear

■ Check-Back

- Sender initiates message
- Receiver accepts message, reads it back
- Sender confirms that read back is correct

■ Post-Case Debriefing

- Covers both teamwork & taskwork
- What went well
- What can be improved
- Specific plan for improvement

Teamwork Competency: Leadership

■ Huddle

- Ad hoc “touch-base” meeting to regain situational awareness
- Discuss critical issues and emerging events
- Anticipate outcomes and likely contingencies
- Assign resources
- Express concerns

■ Verbalization of Changes in Plans

- Speak aloud new plans, changes in strategy or intervention, and new time lines as procedure progresses

■ Delegation

- Distribution of tasks or assignments by surgeon or anesthesiologist to a specific team member

■ Team member assumes responsibility for delegated task

Teamwork Competency: Mutual Support

■ Feedback

- Timely
- Respectful
- Specific
- Directed toward improvement
- Considerate

■ Task Assistance

- Team members request or offer and provide assistance and resources to and from one another
- Long-term responsibility maintained by requestor

■ Two-Challenge Rule

- Concerns voiced assertively at least two times

■ CUS

- Used to convey escalating safety concerns in assertive way
- I am Concerned
- I am Uncomfortable
- This is a Safety issue

■ DESC

- Method for managing and resolving conflict
- Describe the situation
- Explain concerns
- Suggest alternatives
- Consequences stated

Teamwork Competency: Situation Monitoring

■ Cross Monitoring

- Process of monitoring the actions of other team members for the purpose of sharing the workload and reducing or avoiding errors
- Checking status of patient, team members, environment, and progress toward goals

■ Number of Circulator Exits from Case to Retrieve Supplies

- Tally of number of times circulator must leave room to retrieve supplies

June–July 2008, consisted of a four-hour didactic session, including interactive role-playing activities. Trainers were members of the project-planning team who were certified as Master Trainers, including surgeons, nurses, and administrators. The three trained teams attended training together as an interdisciplinary team—including anesthesiology providers.

METHOD OF EVALUATION AND MEASURES

A multilevel training evaluation framework was adopted

based on Kirkpatrick’s (1994)²⁹ four levels of training evaluation. Specifically, the evaluation included (1) trainee reactions (that is, degree to which participants liked training, believed it would help them with their job), (2) trainee learning (degree to which training content was acquired by the trainees), (3) behavior on the job (degree to which learned behaviors transferred to the job), and (4) results (degree to which teamwork behaviors enacted on the job produce safety/quality). We investigated patient safety culture as a Level 4 outcome, which may

be considered a proxy outcome because it is not a direct measure of care outcomes such as number of events or infection rates, for which a low base rate can be problematic.

Level 1. Trainee reactions were measured immediately after each training session via an 11-question survey that included 3 open-ended questions. Trainees rated their level of agreement with 8 statements on a 7-point Likert scale (4 = neutral [“neither”] response). Results were rescaled for data presentation purposes such that 0 is indicative of a neutral response. After rescaling, negative reactions were scored as -3 (“strongly disagree”), -2 (“disagree”), and -1 (“somewhat disagree”) respectively. Positive reactions were as 3 (“strongly agree”), 2 (“agree”), and 1 (“somewhat agree”).

Level 2. Trainee learning was assessed immediately after completion of training using the 23-question TeamSTEPPS learning benchmark test,²⁹ which included declarative knowledge items (for example, “What is the best method of communicating information to all team members during an emergency or complex procedure?”) and strategic knowledge items (for example, choose best answer in given scenario).

Level 3. Behavior in the OR was assessed via 10 baseline and 10 posttraining case observations per team (that is, 30 observations each time period) using an observation tool developed by the authors, the Medical Performance Assessment Tool for Communication and Teamwork (MedPACT). The tool combines elements of the Communication and Teamwork Skills (CATS) observation tool³⁰ and elements of a precase briefing checklist and postcase debriefing checklist developed as part of this project. The teamwork dimensions rated appear in Table 3 with related behavioral indicators. Observers rated the quality (observed and good, variation in quality, expected but not observed) and quantity of each behavioral indicator. Observers also recorded information regarding the proportion of team members sharing information during briefings and debriefings and contingency planning occurring during briefings.

Eleven trained clinical observers—two physicians and nine registered nurses (RNs), all with a combined 96 years of OR experience—rated teamwork behavior. For each case, observations were conducted during the briefing, the surgical case from patient in to patient out, and the case debriefing. Observers participated in a two-hour training program developed by experienced training experts to eliminate common rating biases (for example, leniency) and ensure shared understanding of the teamwork dimensions.

Interobserver reliability was assessed using a sample of 14 cases (8 baseline, 6 posttraining) in which two independent observers observed the same case. The percentage of agreement,

Cohen’s Kappa (k) and interclass correlations (ICC) were analyzed for all 14 cases overall and separately for both data collection periods. Kappa levels of .5 and above can be considered acceptable, while acceptable levels of ICC tend to be .8 or higher.³¹ Overall, raters demonstrated 90% agreement for all 14 cases (k = .595, ICC = .79). There were no meaningful differences in reliability between the two time periods.

After each observed case, participants were asked to complete a condensed version of the Operating Room Teamwork During Last Surgical Case Survey³² to assess their perceptions of teamwork during the case.

Level 4. Results included scores on four dimensions of the HSOPS⁴: *teamwork within unit, feedback and communication, communication openness, and overall patient safety grade*. These four dimensions were chosen because they tapped specific TeamSTEPPS training objectives. Participants also completed the *Teamwork and Communication* dimension of the Operating Room Management Questionnaire,³² which includes 24 questions related to roles and responsibilities, communication, and feedback. All participants completed these measures one month before training and one month after.

Results

LEVEL 1. REACTIONS

As shown in Figure 1 (page 138), trainees reacted positively to the training in terms of both organization and viability. For example, 81% felt more confident about their ability to work as an effective team member after training. Trainee reactions (52%) were least positive regarding perceived ability to teach another about TeamSTEPPS; however, this was not an overarching goal of this QI intervention.

LEVEL 2. LEARNING

Scores on the learning benchmark test were computed as the proportion of correct answers out of the total number of questions for each participant. A one-way analysis of variance (ANOVA) indicated that scores did not differ significantly between the three training classes ($F [2, 29] = 1.31, p = .29$). The average test score across all trainees was 92% correct.

LEVEL 3. BEHAVIORAL OBSERVATIONS

Analyses of the behavioral observation data were conducted using two (training condition) by two (observation period) analyses of covariance (ANCOVAs) or multiple analyses of covariance (MANCOVAs) to control for the potential effects of team membership and preexisting differences between the trained and nontrained teams. Team membership was effect

Participant Reactions to Training

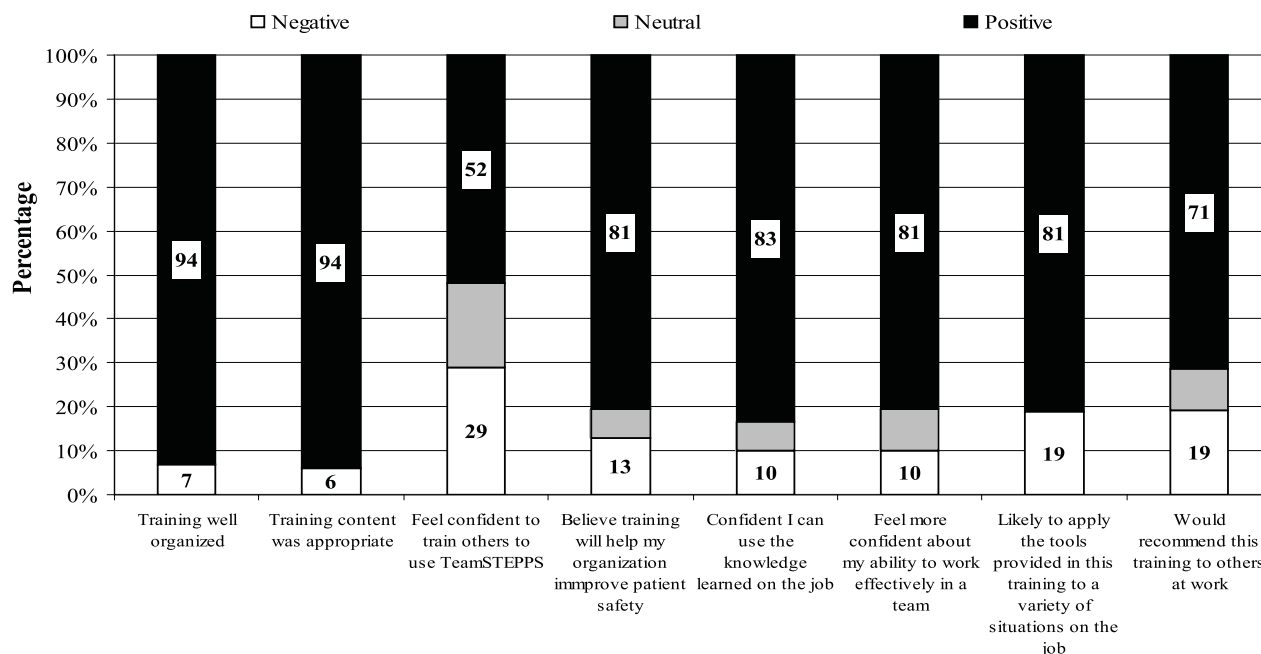


Figure 1. Trainees reacted positively to the training in terms of both organization and viability.

coded and entered as a covariate term to account for the fact that data were collected for the same teams over time, thus controlling for potential team membership effects and pre-existing differences between teams. MANCOVA was used in instances where there were multiple behavioral indicators for a given teamwork dimension.

Briefing. The proportion of observed cases in which a briefing was initiated by the surgeon, the proportion of team members sharing information, and frequency of contingency planning were tested using 2X2 ANCOVA. For the proportion of cases in which the surgeon initiated a briefing, results demonstrated a significant interaction between condition and observation period, indicating that in comparison with the control teams, trained teams engaged in significantly more pre-case briefings after attending training ($F [1, 147] = 35.01, p < .001$, partial $\eta^2 = .19$; Figure 2, page 139). In addition, there was a significant condition-observation period interaction for the proportion of information sharing ($F [1, 128] = 11.47, p < .001$, partial $\eta^2 = .08$), meaning that trained team members were also more willing to speak up and participate during briefings compared with control team members. This pattern of results was also present in the frequency of contingency plan discussions ($F [1, 145] = 5.00, p < .05$, partial $\eta^2 = .03$).

Case Observation Form. For each teamwork dimension,

2X2 MANCOVA analyses were performed on scores for each behavioral indicator rated “observed and good.” Several behavioral indicators were used to assess each of the four categories. However, some indicators were excluded from MANCOVA analyses because they did not correlate significantly with other dimension variables. For example, the MANCOVA analysis for the *communication* dimension excluded the time-out behavioral marker because it did not correlate significantly with the other four behavioral indicators associated with communication: handoffs, SBAR (Situation, Background, Assessment, Recommendations), call-out, and check-backs. The analysis of *mutual support* only included feedback and task assistance ($r = .67$). *Situation monitoring* included cross monitoring and a count of the number of times the circulator exits and enters the OR. Huddles, verbalizing changes in plans, and delegation were all significantly correlated and used in the multivariate analysis of variance (MANOVA) of the *leadership* dimension.

Analyses revealed significant interactions between training condition and observation period for *communication* ($F [4, 134] = 3.15, p < .05$; Wilks’ Lambda = .91; partial $\eta^2 = .09$) and *mutual support* ($F [2, 143] = 6.41, p < .01$; Wilks’ Lambda = .92; partial $\eta^2 = .08$). These results indicate that the trained group, when compared with the control group, improved significantly. However, the interaction term did not reach statistical signif-

Percentage of Cases in Which the Surgeon Initiated a Briefing, Across Time and by Group

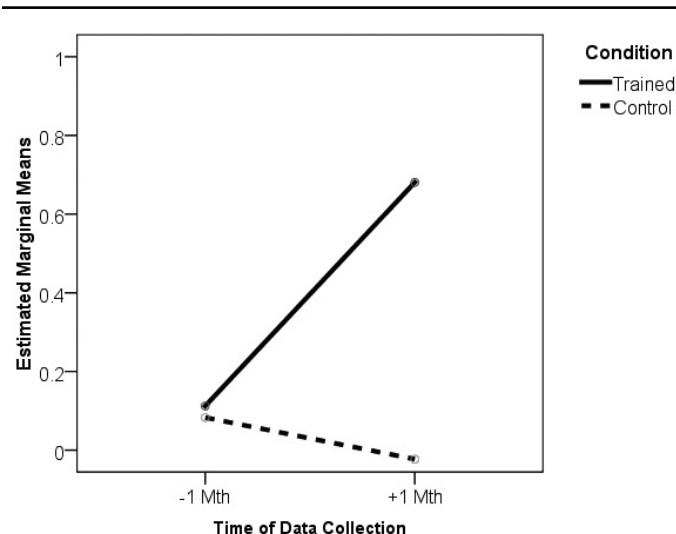


Figure 2. In comparison with the control teams, trained teams engaged in significantly more precase briefings after attending training; -1 Mth, one month before training; +1 Mth, one month after training.

ificance for *leadership* or *situation monitoring*. For *leadership*, observation period ($F [3, 132] = 5.07, p < .01$, Wilks' Lambda = .9; partial $\eta^2 = .1$) was significant, while training condition and the interaction term were not significant. For *situation monitoring*, neither main effect nor the interaction term was significant. These results are summarized in Table 4 (right).

Debrief. The frequency of debriefs was extremely low for both groups during initial observations and remained extremely low for the control group after training. Therefore, debrief analyses focused on the posttraining observation period of the trained group only. The team training load for each team (that is, the proportion of members on the team who received training) was found to be significantly correlated to the debrief participation ratio (the ratio of the number of people participating in the debriefing over the total number of people present ($r = .52, p < .01$). This indicates that training significantly affected the degree to which team members participated in debriefing. In addition, team-training load was significantly correlated with both teamwork ($r = .53, p < .01$) and taskwork ($r = .59, p < .01$) discussions, indicating that the more trained people present during debriefing, the more teamwork- and taskwork-related issues were discussed.

Perceptions of Teamwork During Cases. A 2X2 ANCOVA controlling for team was conducted to assess the effects of train-

Table 4. MANOVA Results for Observation Form Based on Training Condition and Observation Period*

Teamwork Category	df	F	p Value
Communication	4, 134	3.04	< .05
Mutual Support	2, 136	4.36	< .05
Situation Monitoring	4, 150	3.92	< .01
Leadership	3, 135	1.03	> .05

* F values are provided are for the interaction; MANOVA, multivariate analysis of variance; df, degrees of freedom.

ing on team member perceptions of teamwork during actual cases. The interaction term was not significant ($F [8, 132] = 2.075, p = .15$, partial $\eta^2 = .02$), indicating that significant differences in the trends in case survey scores between the control group teams and the trained teams were not detected. The means for the two groups, however, demonstrated trends, suggesting that the trained team maintained perceptions of teamwork after training ($M_{pre} = 4.99, M_{post} = 5.04$), whereas perceptions of case teamwork declined in the control group ($M_{pre} = 4.98, M_{post} = 3.91$). Individual paired-samples t -tests were conducted for only the three trained teams to determine how many of these teams significantly improved from pretraining to posttraining. Analyses revealed that two of the three teams demonstrated statistically significant increases in their perceptions of teamwork quality during their cases after training (Team A: $M_{pre} = 4.2, M_{post} = 4.7$; Team C: $M_{pre} = 4.1, M_{post} = 4.5$).

LEVEL 4. RESULTS

Percentage of Positive Responses. HSOPS results were first compared on the basis of the percentage of positive responses. The AHRQ benchmarking initiative reports results for the HSOPS in terms of the percentage of respondents who score 4.00. Percent positive scores were derived using the prescribed AHRQ methodology.⁵ As shown in Figure 3 (page 140), the trained group increased the percentage of positive responses on all four dimensions from baseline to follow-up, with the largest increase occurring for *communication openness* (31% to 51% positive). However, the nontrained group also demonstrated gains in percent positive on all four dimensions. These results must be interpreted with extreme caution because of small sample size at the control site during follow-up and suggest several potential threats to validity, including differential attrition (that is, dissatisfied individuals disproportionately dropping out of the control group), compensatory equalization (control group tries to perform equally well as the treatment group), and reac-

tivity to testing/observation (pre-test/pre-observations may have increased control group sensitivity to the experimental variable). Attempts were made to minimize these threats by using groups at separate campuses. Although the control group demonstrated increases on the HSOPS, this pattern was not mirrored in their actual behavior during observed cases.

Mean Differences. ANCOVAs covarying out *team* were conducted on baseline mean HSOPS and Operating Room Management Attitudes Questionnaire (ORMAQ) responses to explicitly test for potential baseline differences between groups. As depicted in Table 5 (page 141), the analyses did not detect significant preexisting mean differences between the trained and control group on any of the HSOPS or ORMAQ dimensions.

Repeated measures ANOVA analyses conducted for each of the four HSOPS dimensions indicated that statistically significant gains were only found for the dimension *teamwork within units* ($F [1, 25] = 21.7, p < .001$, partial $\eta^2 = .19$). However, gains did not differ significantly between the trained group and the nontrained group ($F [1, 25] = .98, p = .33$, partial $\eta^2 = .04$).

Similarly, a repeated measure ANOVA on mean ORMAQ scores did not demonstrate statistically significant differences in the amount of change in teamwork attitudes over time between the two locations ($F [1, 24] = .99, p = .33$, partial $\eta^2 = .04$). However, separate one-way repeated measures ANOVAs were also run for each group to investigate the amount of change when considering each campus separately. Results indicated that the trained group's perceptions of teamwork increased significantly after training ($F [1, 18] = 7.05, p = .02$, partial $\eta^2 = .28$), whereas the nontrained group did not statistically significantly change over time ($F [1, 6] = .271, p = .62$, partial $\eta^2 = .04$).

Percentage of Positive AHRQ HSOPS Responses by Condition and Data Collection Time Period

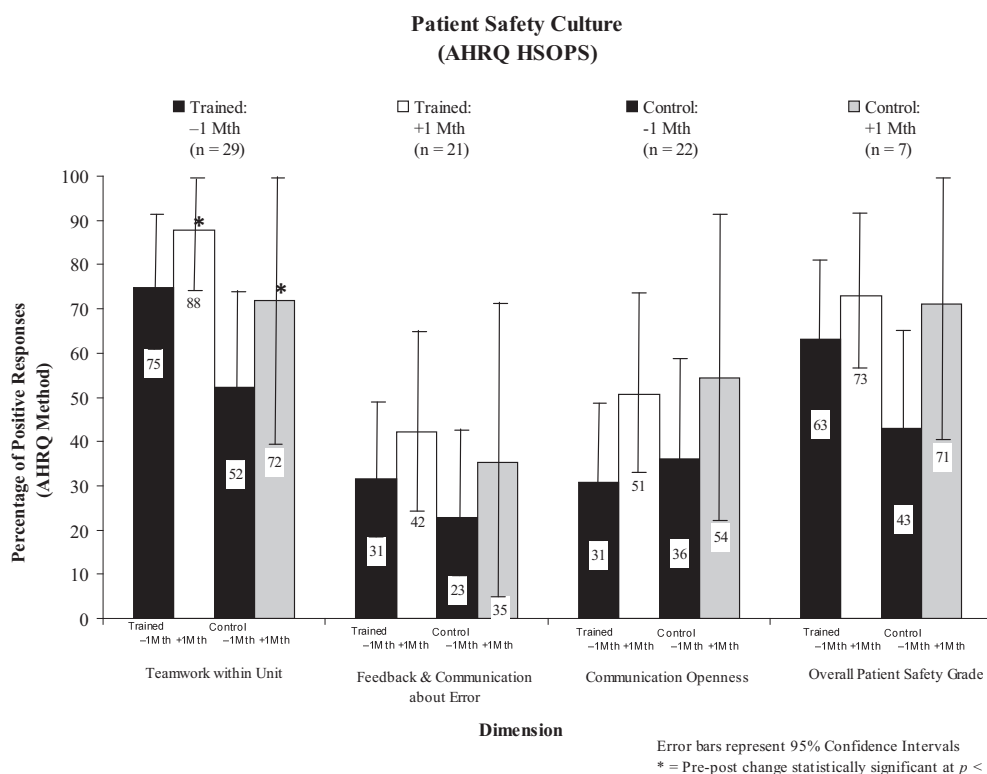


Figure 3. Although the trained group increased the percentage of positive responses on all four dimensions from baseline to follow-up, the control group also demonstrated gains in percent positive on all four dimensions. AHRQ, Agency for Healthcare Research and Quality; HSOPS, Hospital Survey on Patient Safety Culture; -1 month, one month before training; +1 month, one month after training.

Discussion

The current QIP provides a multilevel evaluation of the TeamSTEPPS training program within a surgical unit, measuring four levels of outcomes—reactions, learning, behavior in the OR, and proxy organizational results. Other evaluations of TeamSTEPPS have also provided supportive evidence for mental health facilities,³³ critical access hospitals,³⁴ as well as pediatric ICU and surgical ICU³⁵ teams. The project is unique in its inclusion of a control group, against which the results of the treatment group could be compared. Results provide empirical support for the effectiveness of the TeamSTEPPS program in terms of all four levels of evaluation—trainees reported that training was useful and viable, achieved learning benchmarks, increased the degree to which quality teamwork occurred in the OR suite, and demonstrated some positive changes in patient safety culture.

Table 5. AHRQ HSOPS and ORMAQ Descriptive Statistics by Dimension, Group, and Data Collection Time Period*

	Baseline (–1 Mth) Mean (S.D.)		Follow-up (+1 Mth) Mean (S.D.)	
	Trained (n = 29)	Control (n = 22)	Trained (n = 21)	Control (n = 7)
AHRQ HSOPS				
Teamwork Within Units	3.78 (.47)	3.07 (.93)	4.22 (.48)	3.67(.49)
Feedback & Communication About Error	3.16 (.72)	2.71 (.99)	3.24 (.92)	3.10 (.69)
Communication Openness	3.47 (.82)	2.98 (.98)	3.62 (.75)	3.26 (.71)
Overall Patient Safety Grade	3.63 (.80)	3.53 (.74)	4.00 (.96)	3.71 (.81)
ORMAQ				
Overall Teamwork & Communication	4.89 (.58)	4.72 (.80)	5.18 (.61)	4.54 (1.21)

*AHRQ, Agency for Healthcare Research and Quality; HSOPS, Hospital Survey on Patient Safety Culture; ORMAQ, Operating Room Management Attitudes Questionnaire; –1 mth, one month before training; +1 mth, one month after training; S.D., standard deviation.

LIMITATIONS

Several limitations should be considered in interpreting these results. First, the control group did not meet all qualifications of an exactly matched control group. Although both the control group and trained teams included similar specialties, results may be confounded by campus differences. We attempted to statistically control for these differences in our analyses. Second, low statistical power may have limited our ability to detect certain effects, especially in the observational analyses, because of small sample size. However, despite limited power, effects were still detected, suggesting that these results provide a lower-bound estimate of the true magnitude of the effects training. In addition, in the context of training evaluation, Arvey et al.³⁶ found that satisfactory statistical power (that is, 85) can be achieved given ANCOVA analyses and a small-to-medium effect size with a total sample size of 50 or more observations. Third, teams receiving the TeamSTEPPS training were all OR teams from a single location. Thus, two potential limitations are the generalizability of TeamSTEPPS effectiveness to other specializations and to other hospital environments. Evidence of generalizability for the effects of TeamSTEPPS can be found when evaluation results are pooled across other evaluation efforts such as those noted. Future studies should evaluate the training program within other departments. In addition, because all trained teams were members of a single location, factors external to the training itself might have contributed to the program's success. Furthermore, though the current project included a relatively small sample size, inclusion of the control group adds power to the statistical analyses.

NEXT STEPS

The results of the current evaluation were provided to cam-

pus- and system-level administrators and frontline providers. The hospital system has since integrated elements of TeamSTEPPS into orientation training provided to all incoming hospital employees, including nonclinical staff. It is now creating a team-training steering group to create a spread strategy that would incorporate team training across multiple clinical areas, not just ORs, and integrate team-training behaviors into performance improvement initiatives across the hospital system. In addition, the formal leadership training team is inserting team-training principles and concepts into its curriculum.

Conclusions

Overall, these results support the use of team training, specifically TeamSTEPPS, as a viable methodology for improving the quality of teamwork in health care, specifically in the OR service line. In addition, the positive increases at all levels of evaluation reported in the current QIP were achieved after only four hours of didactic instruction (including low-fidelity opportunities for practice). Future projects should consider augmenting team training with simulation-based opportunities for practice, such as anesthesia Crew Resource Management, which may result in even greater positive effects.

As care providers strive to provide optimal care to patients with more complex diagnoses, the importance of teamwork will continue to grow. Therefore, it is critical that health care professionals learn to not be only proficient clinicians but also proficient team members. As the results presented in this article suggest, incorporating team training into the health care system will contribute to continued improvements in quality care. **J**

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